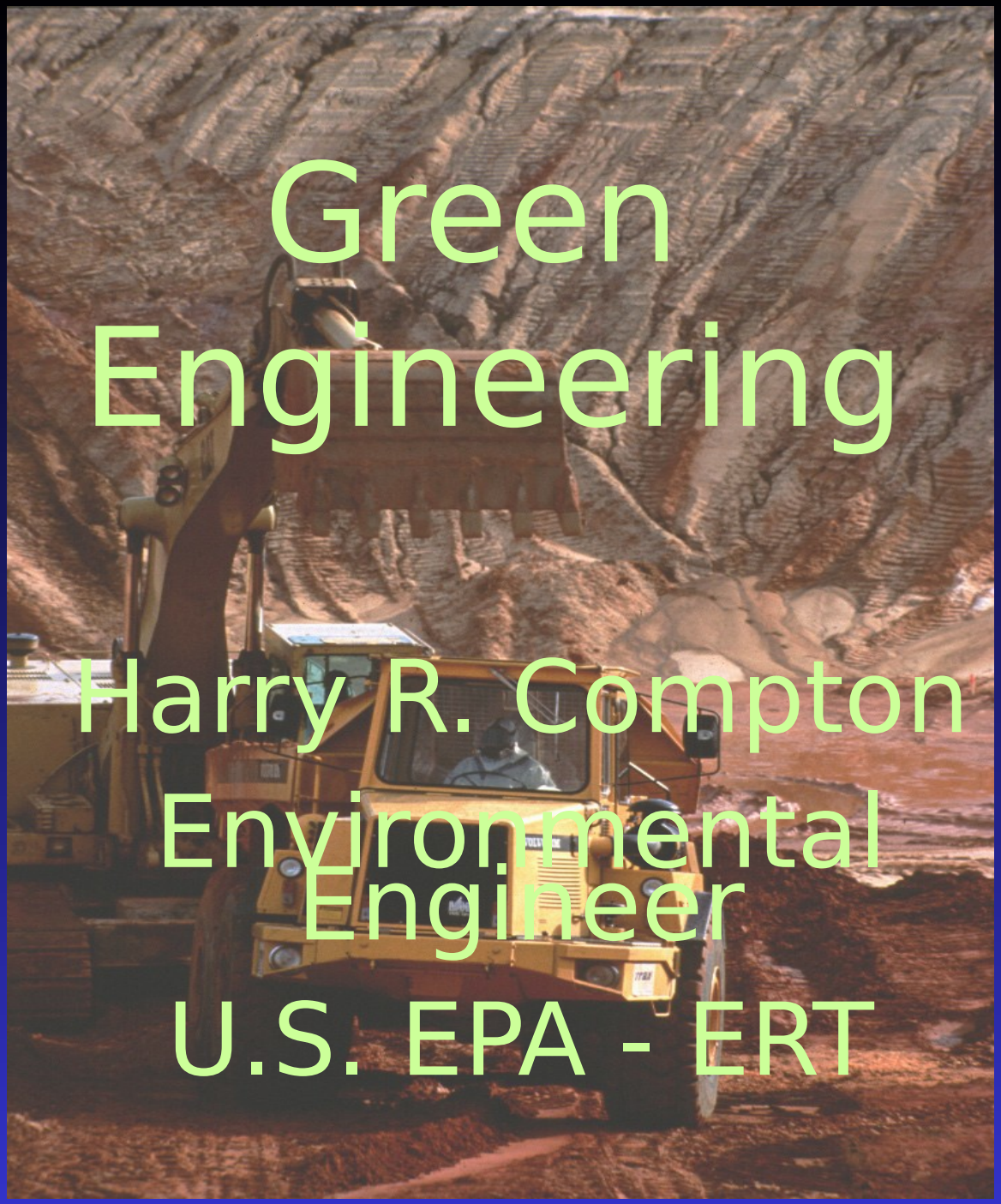


Green Engineering

Harry R. Compton
Environmental Engineer
U.S. EPA - ERT

FLYING J
TRAVEL PLAZA
conoco
ATM
C-Store
RV Facilities
Thad's
RESTAURANT & BUFFET
46 Miles - Exit 2
4 16 98

FLYING J
TRAVEL PLAZA
conoco
ATM
C-Store
RV Facilities
46 Miles - Exit
Vesco

Why use wastes?

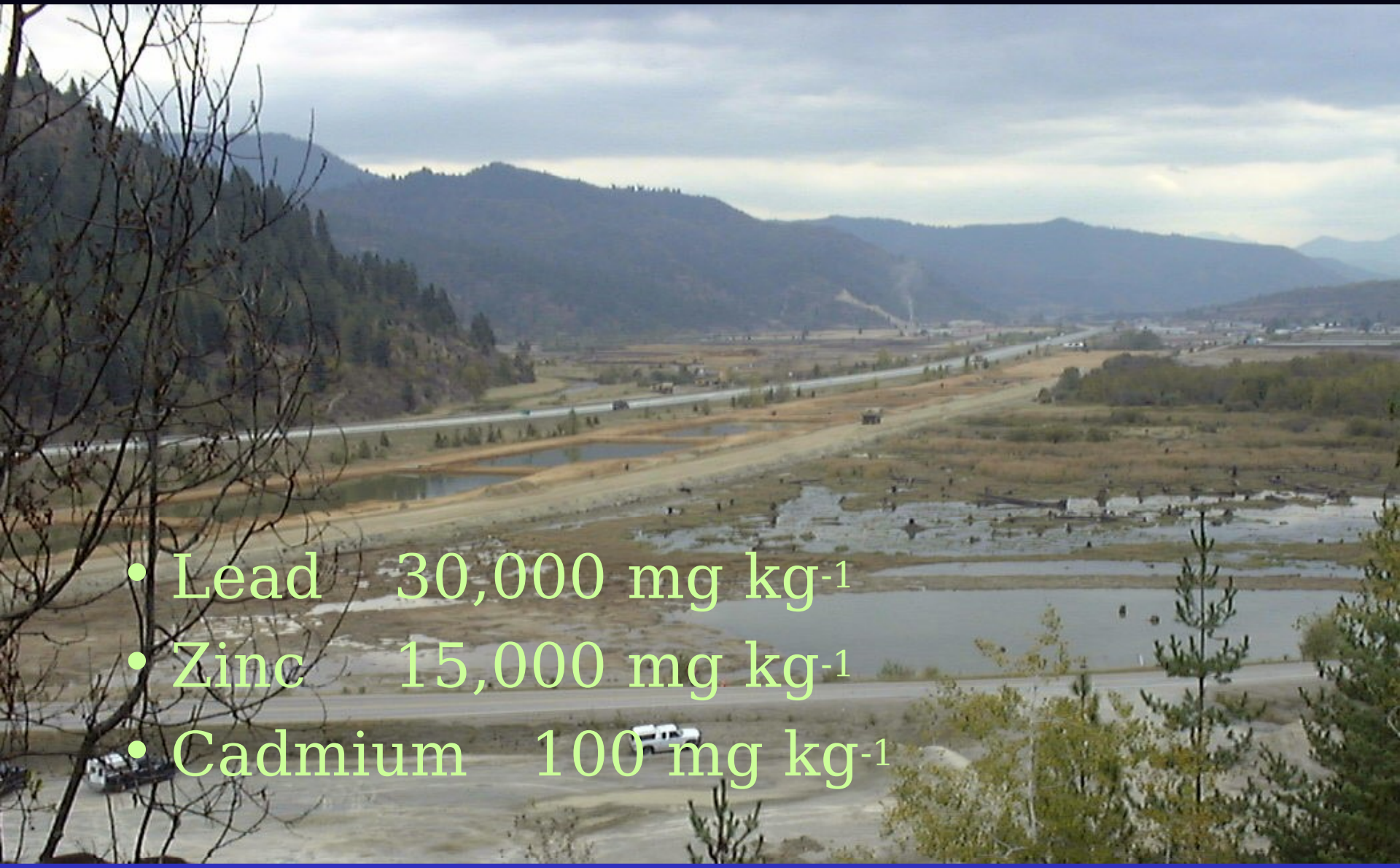
- **Different wastes can be used to remedy a number of factors that may potentially contribute to a soil's inability to support a vegetative cover.**
  - **-- pH**
  - **-- soil fertility**
  - **-- soil physical properties, and**
  - **-- potentially toxic concentrations of trace metals**

- **By combining different materials together, and applying to the soils in-place, soil problems can be corrected.**
  - **-- lower costs**

Scientific basis of treatments

- Biosolids/compost add:
  * **nutrients**
  * **organic matter**
  * **metal complexing ability**
- Wood ash/waste lime add:
  * **pH adjustment**
  * **adhesive properties**
  * **nutrients**
- Wood waste/other C-rich residuals:
  * **limits N availability**
  * **adds bulk**
  * **physical soil benefits**

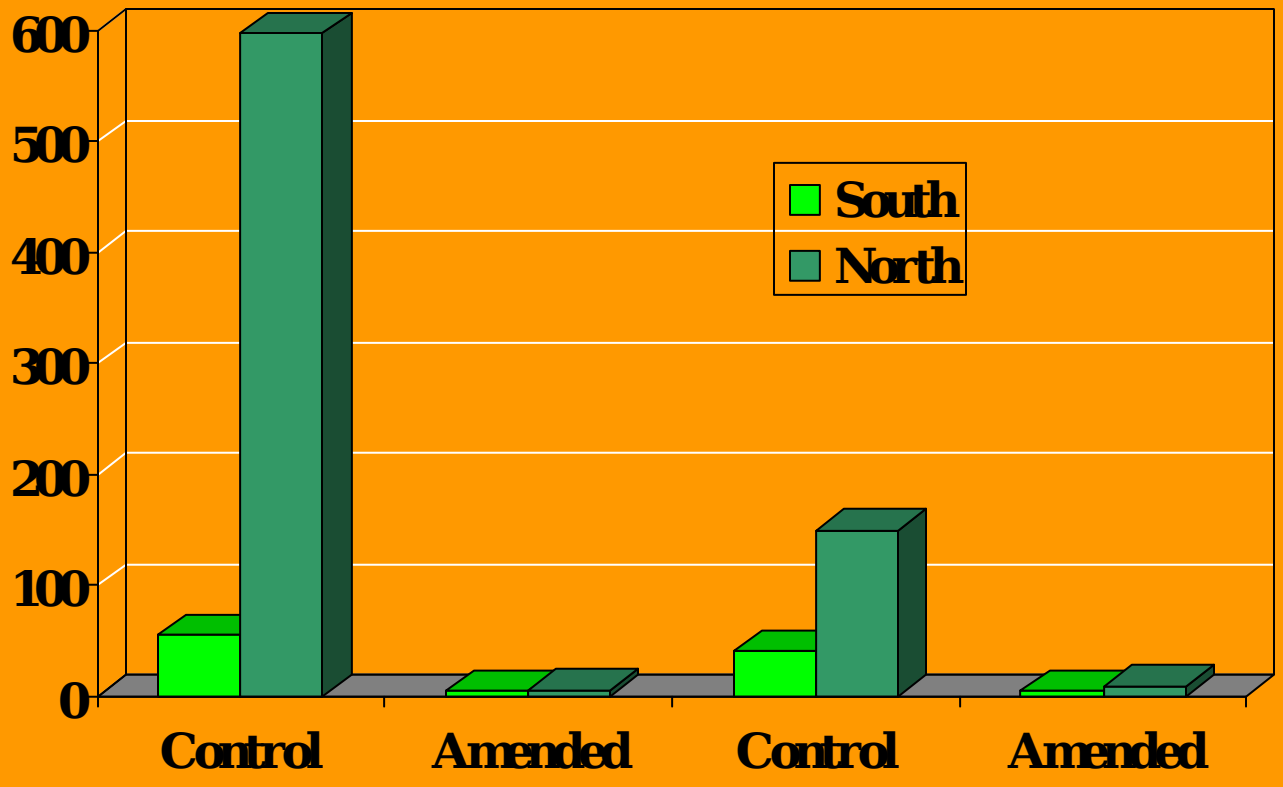
Bunker Hill - wetland restoration



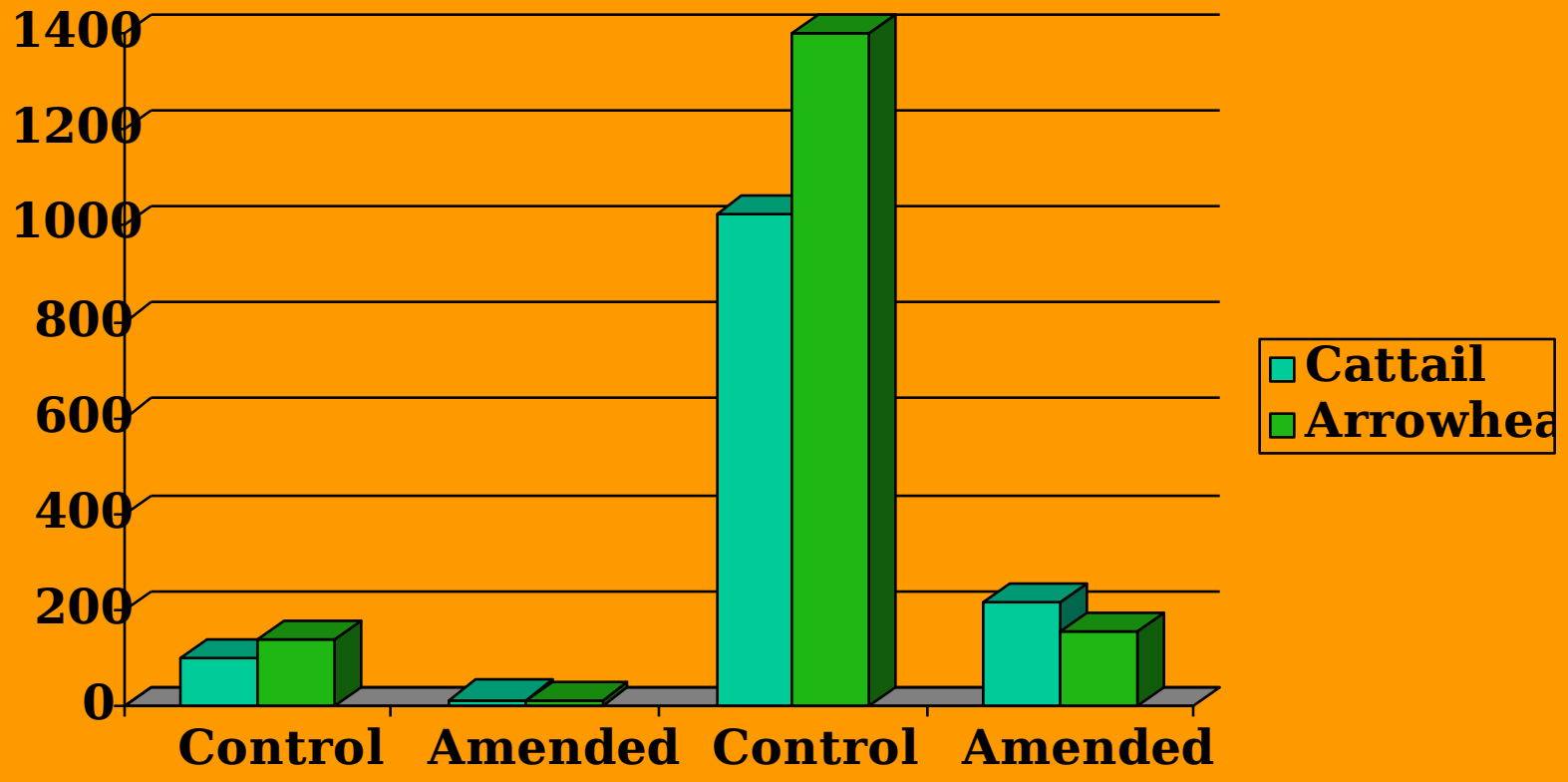
- Lead 30,000 mg kg^{-1}
- Zinc 15,000 mg kg^{-1}
- Cadmium 100 mg kg^{-1}

Coeur d'Alene Wetlands 1998- 2001

Wetland - Plant lead (mg kg^{-1})



Other metals



Pb Speciation

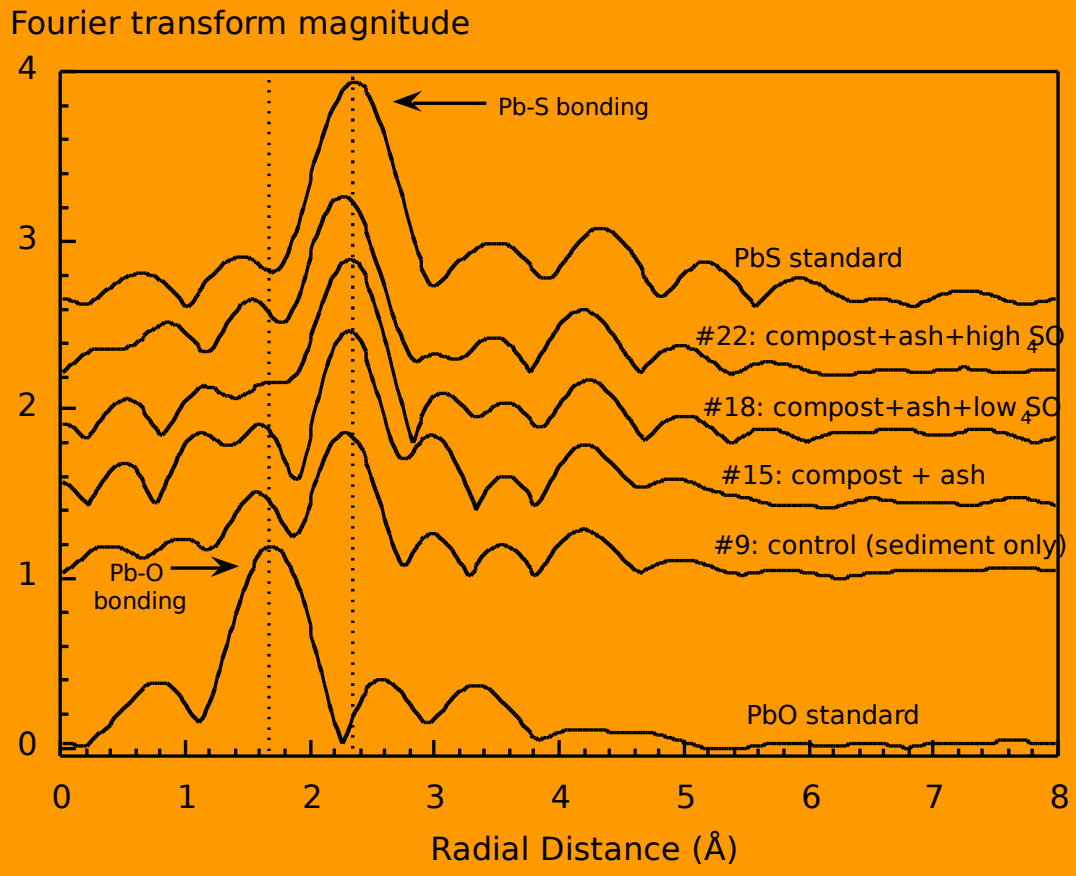


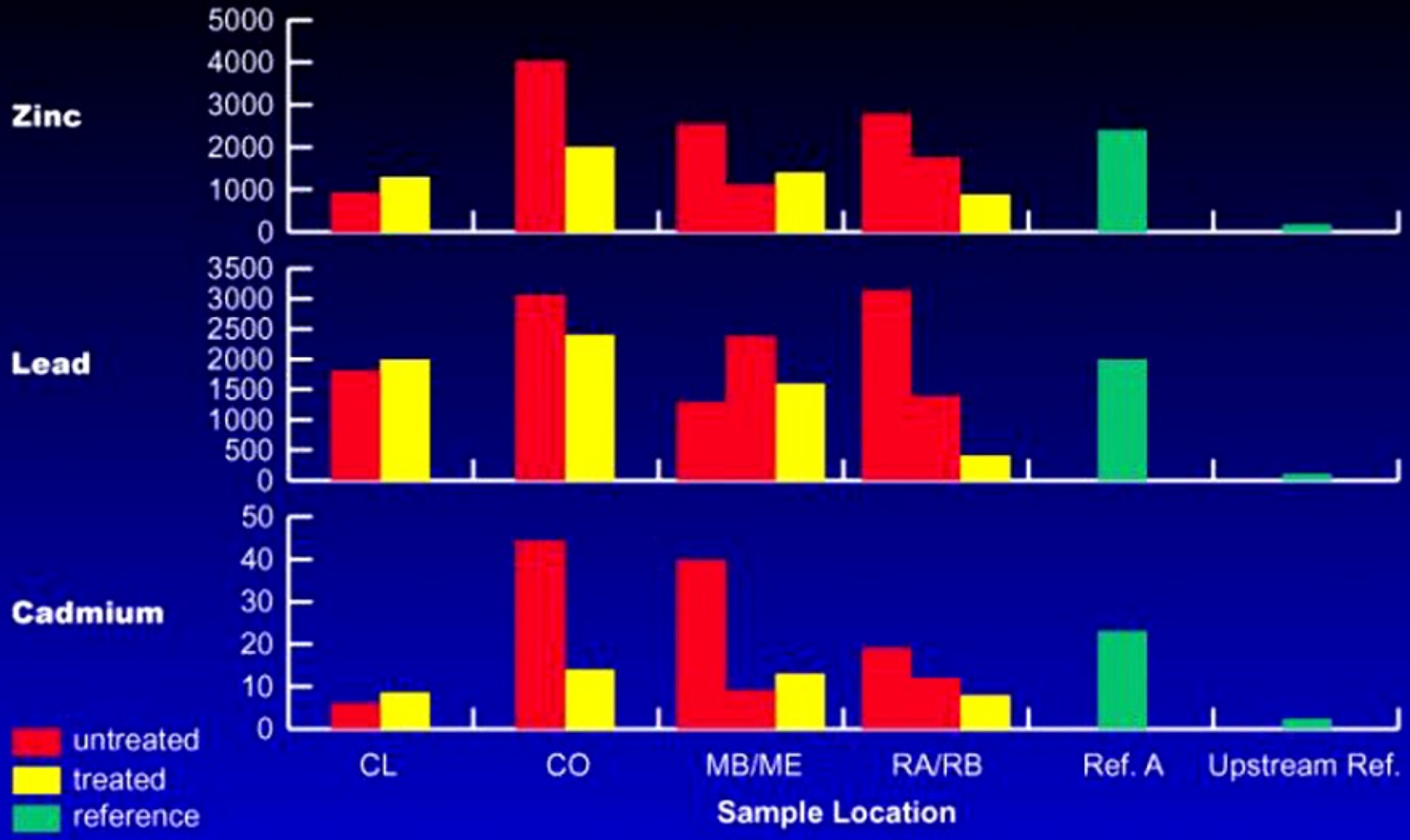
Fig. 1. Radial structure functions (RSFs) derived from Fourier transformation of EXAFS data (w=3) for contaminated sediment subjected to various treatments.
The Pb-S bonding apparent for all sediment samples indicates a dominance of Pb-sulfide.

4 14 98

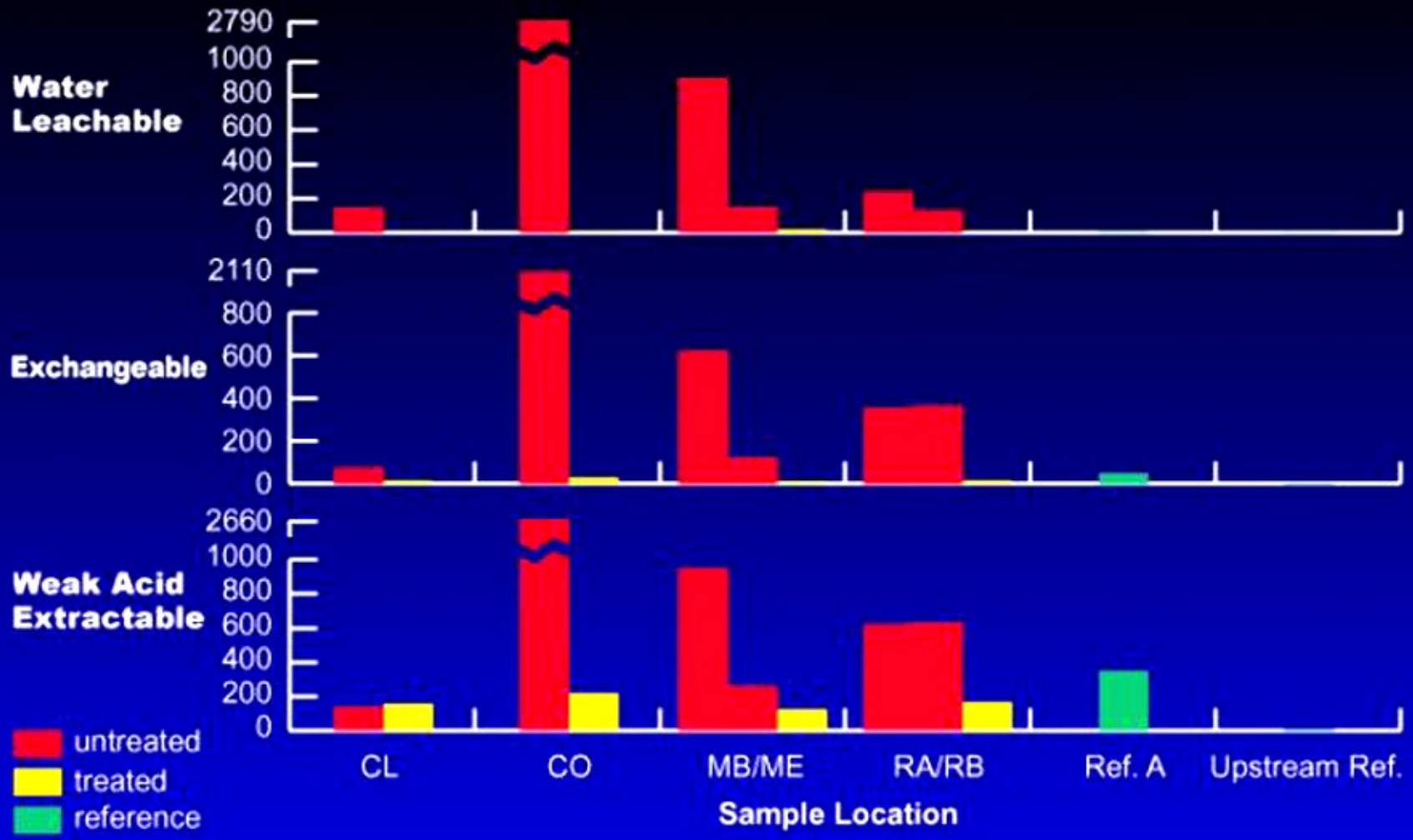
Filling vehicle

Application

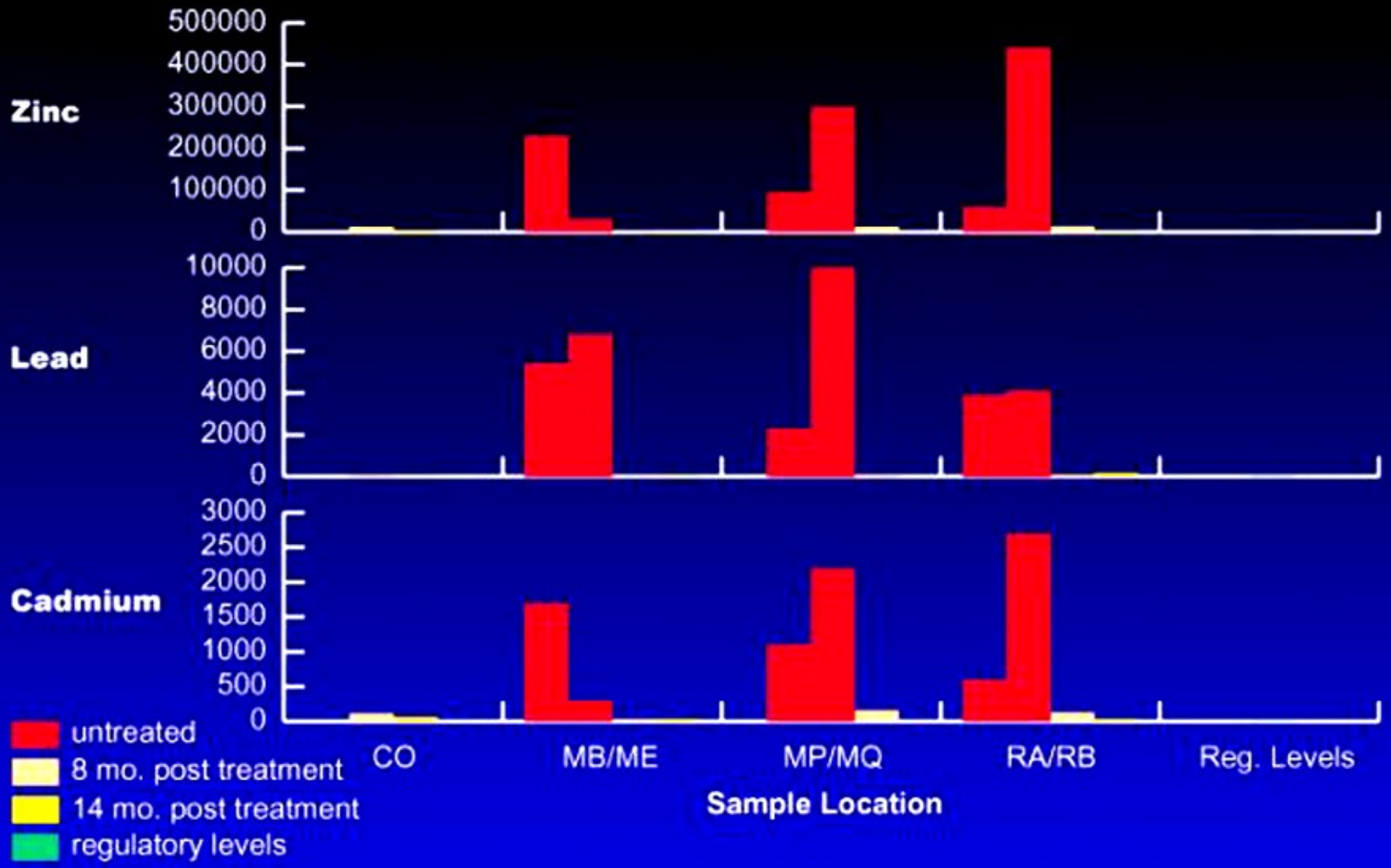
TAL Metals in Soil (mg/kg)



Availability of Zinc in Soil (mg/kg)



Metals in TCLP Extracts (mg/L)



Ryegrass *(Lolium perenne)* Assays - Germination

Sample	Untreated (%)	Treated (%)
CL	0	85.7
CO	0	71.4*
MB/ME	-	100.0
RA/RB	-	90.5
Ref. A	-	95.2
Upst. Ref.	-	90.5
Lab Con.	85.7	95.2

* significantly < reference samples and/or control sample

Earthworm *(Eisenia foetida)* Assays - Survivorship & Biomass/Organism

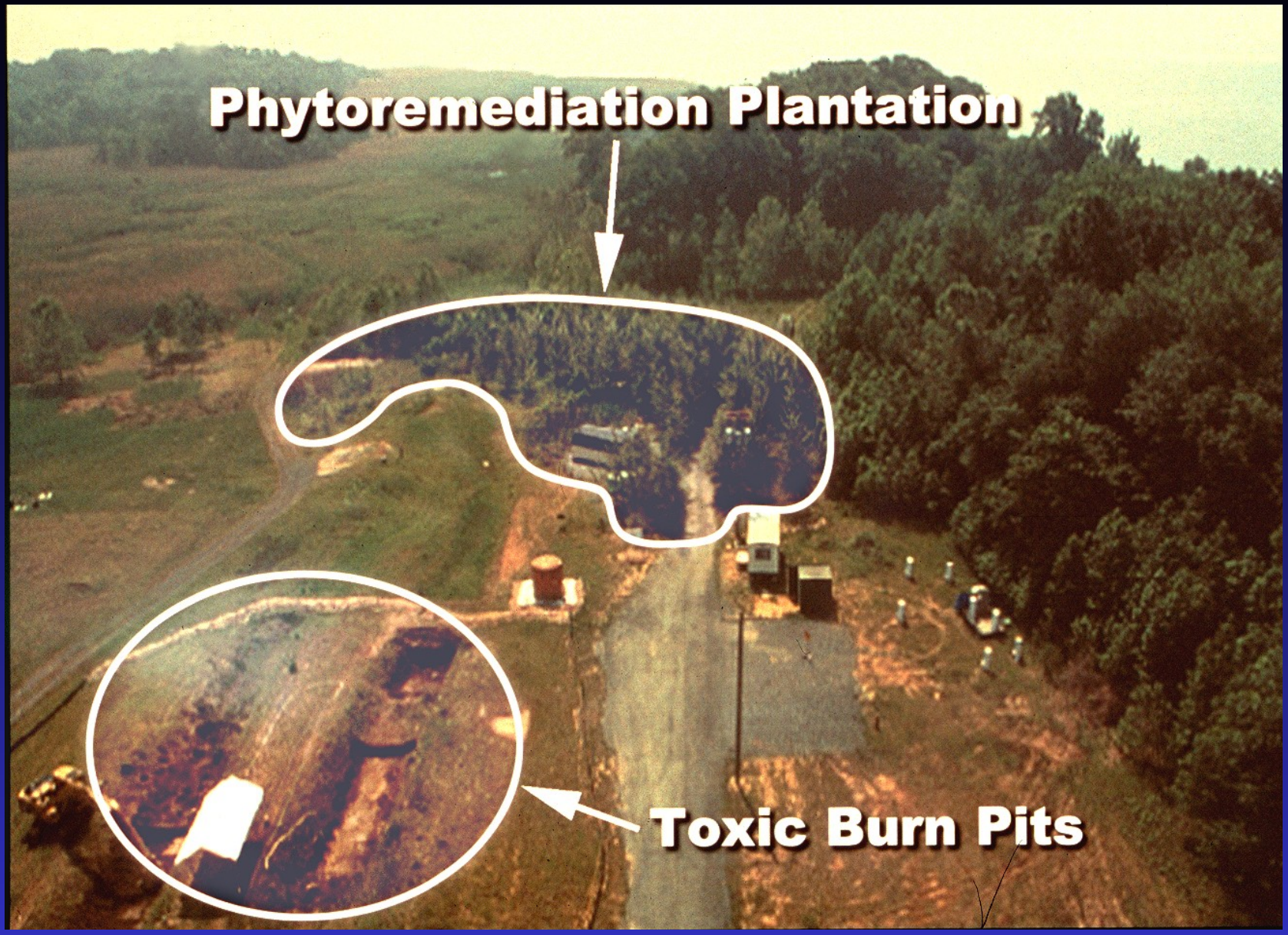
Sample	Untreated		Treated	
	Survival (%)	Biomass (mg)	Survival (%)	Biomass (mg)
CL	0	NA	100.0	329.3
CO	0	NA	98.9	323.0
MB/ME	0/0	NA	90.0	372.0
RA/RB	0/0	NA	10.0*	280.3
Ref. A	-	-	98.7	244.0
Upst. Ref.	-	-	96.7	196.0
Lab Con.	100	not measured	100.0	258.6

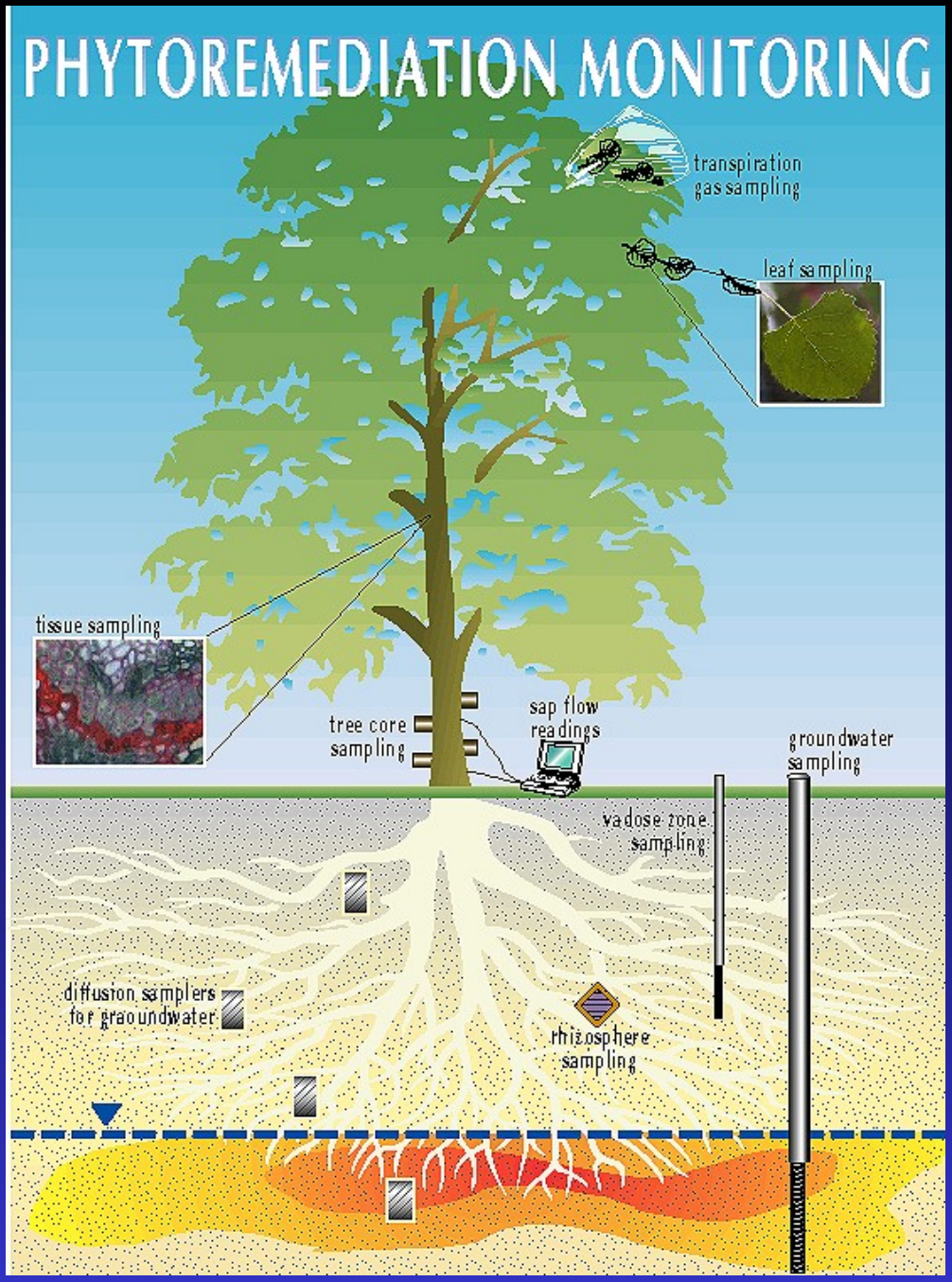
* significantly < reference samples and/or control sample

Open Burning/Detonation, J-Field Toxic Pits (circa 1960s)

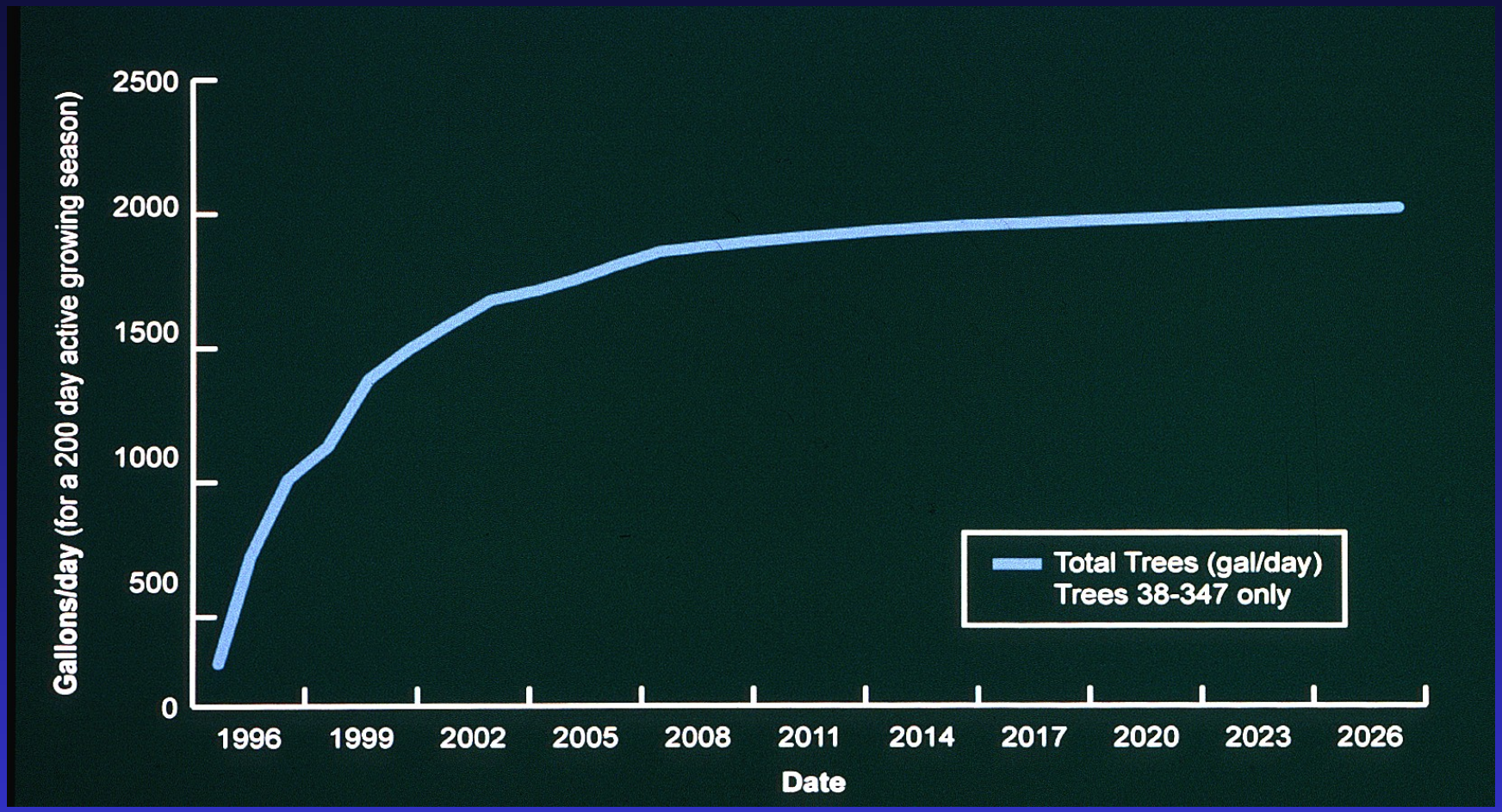
Contaminants of Concern

	Groundwater (µg/L)
1,1,2,2-tetrachloroethane (1122)	390,000
trichloroethene (TCE)	93,000
cis-1,2-dichloroethene (c-DCE)	81,000
tetrachloroethene (PCE)	11,000
trans-1,2-dichloroethene (t-DCE)	29,000
1,1,2-trichloroethane (TCA)	7,100

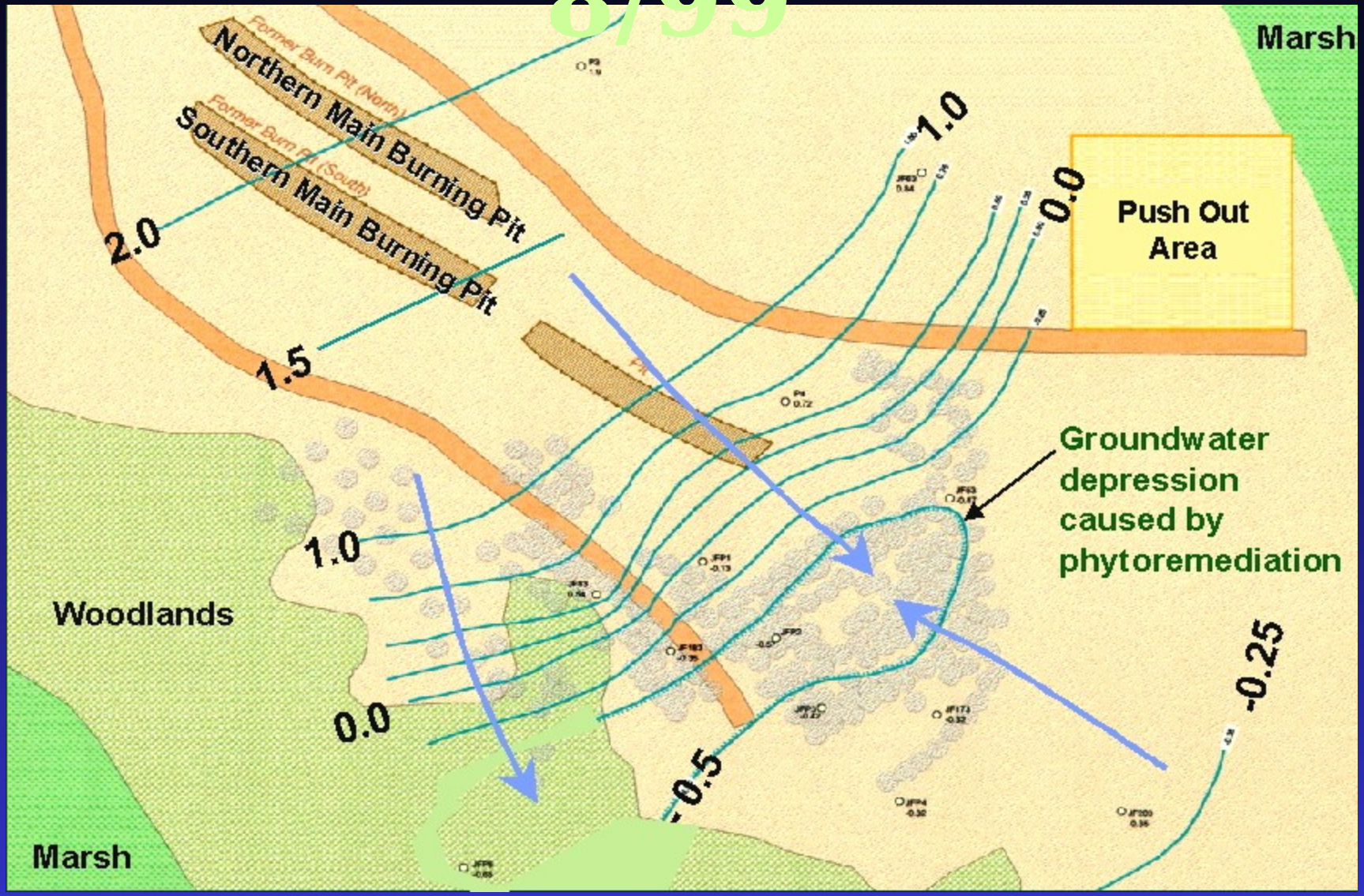

Phytoremediation Plantation
Toxic Burn Pits


PHYTOREMEDIATION MONITORING
transpiration gas sampling
leaf sampling
tissue sampling
tree core sampling
sap flow readings
groundwater sampling
vadose zone sampling
diffusion samplers for graoundwater
rhizosphere sampling

Predicted Daily Sap Flow Over 30 Years for the Total Remediation Area



Groundwater Elevation 8/99



Metals in Biosolids

- **Regulatory limit**

(pollutant concentration limits)

- **Cadmium**
  - **39 mg kg**
- **Lead**
  - **300 mg kg**
- **Copper**
  - **1500 mg kg**
- **Zinc**
  - **2800 mg kg**

- **National Means**

(1990 national sewage sludge survey)

- **Cadmium**
  - **7 mg kg**
- **Lead**
  - **134 mg kg**
- **Copper**
  - **741 mg kg**
- **Zinc**
  - **1202 mg kg**